The Royal College of Surgeons of England

Ann R Coll Surg Engl 2000; **82**: 18–23

Historical review

John Hunter, Frederick Treves and intussusception

Mark D Stringer, Ian E Willetts

Department of Paediatric Surgery, Leeds Teaching Hospitals Trust, Leeds, UK

Early this century, intussusception in childhood was usually fatal. John Hunter, one of the founding fathers of scientific surgery was amongst the first to accurately describe the clinico-pathological features of the condition and one of the great nineteenth century surgeons, Sir Frederick Treves, suggested a plan of management for intussusception which remains little changed up to the present day.

Intussusception: early history

Although Hippocrates is often credited with the first recorded description of intussusception, it is uncertain whether he identified this condition as a distinct clinical entity from other forms of 'ileus'. However, Hippocrates did suggest the use of small volume oil injection enemas for the treatment of ileus. Should this fail, he suggested connecting a bellows to the anus and inflating the bowel with air[1] — a truly remarkable foresight! One of the earliest records of intussusception can be found in Johann Peyer's monograph of 1677,[2] within which he differentiated intussusception from volvulus of the small intestine and also described the lymphoid follicles of the terminal ileum which bear his name. One year before, Paul Barbette of Amsterdam suggested that operative reduction of intussusception might be feasible.[3] This was first undertaken successfully by Cornelius Velse in an adult patient which he reported in 1742.[4] Over the next 70 years, numerous reports of post mortem findings of intussusception were published, with an occasional description of operative reduction.[5–8] Despite occasional early successes in adult patients, Langstaff discussing Herrin's successful operative reduction of intussusception in France in 1784 commented that:[8] 'the aid of medicine and surgery affords not the slightest prospect of benefit' and that the best chance of cure remained in the patient spontaneously sloughing the invaginated portion of bowel as described by others.[6,7]

John Hunter and intussusception

John Hunter (1728–1793) clearly described the pathological features of intussusception, while suggesting possible mechanisms by which the disease occurs. He identified that:[9] 'This disease happens most frequently in the first fifteen years of life, not occurring so commonly in older people, neither does it, I believe,

Correspondence to: Mr Mark D Stringer, Department of Paediatric Surgery, Clarendon Wing, Leeds Teaching Hospitals Trust, Leeds LS2 9NS, UK. Tel: +44 113 392 6721; Fax: +44 113 392 6609

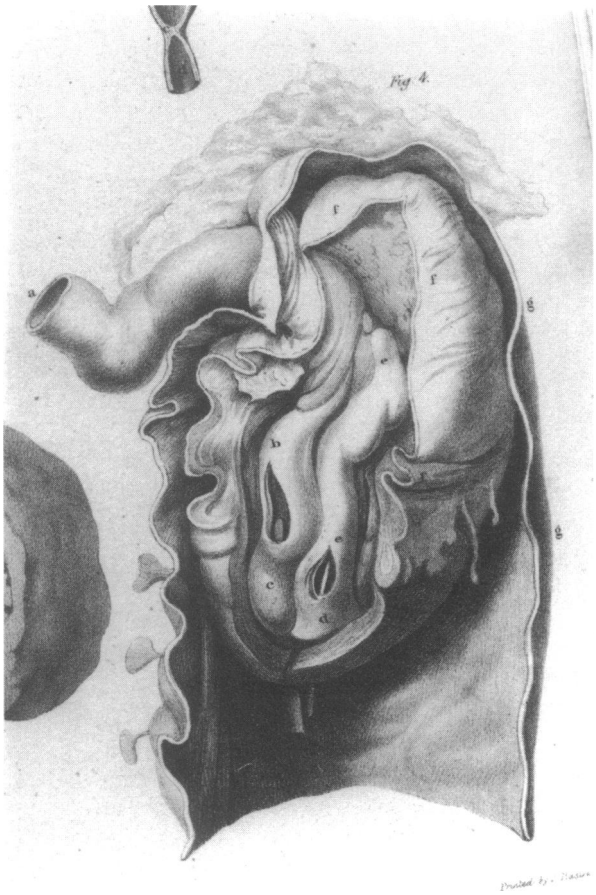

Figure 1 A drawing of Hunter's case of childhood intussusception taken from *The Works of John Hunter FRS*, edited by JF Palmer, 1837 (Plate XXIV, Fig. 4): (a) and (b) ileum, (c) ileum just proximal to ileocaecal valve, (d) and (e) vermiform appendix, (f) colonic intussusceptum, and (g) the colonic intussuscipiens. Reproduced by kind permission of The Royal College of Surgeons of England

ever take place in the colon itself, although we find that gut affected by it.'

In fact, colo-colic intussusception does occur rarely in children and adults.[10] Hunter also carefully distinguished intussusception presenting at the anal margin from rectal prolapse:[9] 'A prolapsus ani...differs from introsusception as not being contained in a gut: for, instead of having an inclosing gut inverting itself by its own action, there is an inclosed gut protruded by the action of the abdominal muscles and the passing of the faeces through it, and the point of inversion is at the extremity of the protrusion, and as it inverts it pushes out of the body.'

In 1789, Hunter presented a case of intussusception in a 9-month-old child who subsequently died of his disease; the report of this account was published in 1793.[11] The pathological specimen can be found in the Hunterian Museum at the Royal College of Surgeons of England and clearly shows a classical ileocolic intussusception (Fig. 1). Hunter read his paper before a select group of surgeons who met each month at Slaughter's Coffee House in St Martin's Lane — 'A Society for the Improvement of Medical and Chirgical Knowledge'. Another group member, Whately, had previously presented an account of the pathological features of an ileocolic intussusception extending around the colon.[12] Hunter's patient (AB). was:[11] 'a large healthy well-looking child, who, as far as appeared, had never been indisposed from his birth, was seized with a strong spasm, stretching himself out suddenly, without having had any symptoms of previous ailment. Either during the spasm, or immediately after it, he passed a very large loose stool, and after that discharged at intervals small quantities of mucous slime, covered over with little specks of recent fluid blood.'

The child was attended by Dr Ash, who suspected that: 'mortification had taken place in the bowels, without being able to guess at the cause'.

Consequently, numerous interventions were attempted including purgatives, fomentations (application of hot or cold medicinal towels to the body), warm baths and various enemas, without success. The patient's strength[11] 'gradually sunk, and his pulse became gradually weaker, although he continued to take the breast eagerly till within a few hours of his death, which happened just sixty hours after the first spasmodic attack.'

At the post mortem examination carried out by Mr Everard Home, an ileocolic intussusception with accompanying intestinal obstruction was identified. Hunter accurately described the gross pathological features of the condition. One of Hunter's other reports also documented an intussusception. This concerned a young woman whose symptoms of colicky abdominal pain and vomiting were attributed to a uterine polyp but, at post mortem examination, she was found to have a jejunal intussusception.[13] Hunter's advice concerning the treatment of intussusception was somewhat unusual. He suggested that the physician induce vomiting, with a view to reversing the peristaltic motion of the gut, which he considered important in the pathogenesis of intussusception. Despite such observations, the outlook for a child with intussusception in the early nineteenth century was appalling and the condition was almost always fatal. By 1877, Leichtenstern[14] was prompted to state that the mortality in reported cases was 88% in the first 6 months of life, 82% in the subsequent 6 months and 72% from 2–10 years.

During this period, operative treatment of intussusception was rarely undertaken. Enemas of various types were employed, although it appears that, as in Hunter's case, many doctors did not use these in an active effort to reduce the intussusception with hydrostatic pressure. Similarly air was also frequently injected into the rectum either by the use of bellows, or by ingenious gas generators. In 1818, a Scottish surgeon, Archibald Blacklock carried out a post mortem examination on a child who had died of an intussusception and found that it could be reduced by using a 'blow pipe'.[15] He subsequently tried the remedy frequently, and 'often with the best result' although it is uncertain from his account whether these successes were in genuine cases of intussusception. In 1838, Samuel Mitchell of Kingston-upon-Thames, wrote to the *Lancet* describing a child with intussusception who he attended in 1836 who presented with 'all the usual symptoms'.[16] The child was initially treated by purgatives and bleeding which were unsuccessful. As a forlorn hope, Mitchell attached an enema tube to a 'common pair of bellows' and inflated the bowels. The child completely recovered, representing the first successful air enema reduction of childhood intussusception in the literature.

Subsequently, many reports on the use of enemas in intussusception were published, including a report of the successful use of tobacco infusion enemas from Richmond, Virginia![17–28] Notable amongst these contributions was that of David Greig, a Scottish surgeon, who in 1864 reported his success in four out of five carefully documented childhood intussusceptions, using hand bellows.[29] These attempts culminated in Hirschsprung's report of 1876 in which he described his experience with controlled hydrostatic pressure reduction.[30] By 1905, Hirschsprung had collected 107 cases of intussusception with a mortality of only 35%, establishing the enema treatment of intussusception used to the current time.[31]

However, enema reduction of intussusception was not universally accepted. Holmes's text on the surgical treatment of diseases of infants and children which appeared in 1868 discusses the recommended treatment of intussusception as:[32] 'Free local abstraction of blood by leeches, followed by warm fomentations or poultices to the abdomen...Food should be given in small quantity. Opium should be given as freely as is prudent. Small doses of calomel at frequent intervals will promote the action of the bowels and control sickness; and the lower bowel should be filled as much as possible with fluid administered through the long tube under chloroform if necessary...An idea has been entertained that by filling the bowel with water or air the intussusception can be unfolded, and thus this cause of obstruction be permanently relieved. I am afraid this is imaginary...distension of the large intestine cannot have any effect in unfolding or reducing the intussusception ... Now if this part of the gut could be inflated, the inevitable effect would be to produce a laceration extending into the peritoneal cavity.'

He similarly condemned laparotomy: 'With regard to cutting into the peritoneal cavity, I would entirely abstain from any such proposal in a case which I regarded as one of intussusception'. It was against this background that one of the greatest nineteenth century surgeons emerged.

Frederick Treves and intussusception

Treves was born in Dorchester in 1853, attending a local school with his life-long friend Thomas Hardy. On the death of his father in 1867, his family left Dorset for Kennington, London, where Frederick was enrolled in the Merchant Taylors' School and succeeded in being an

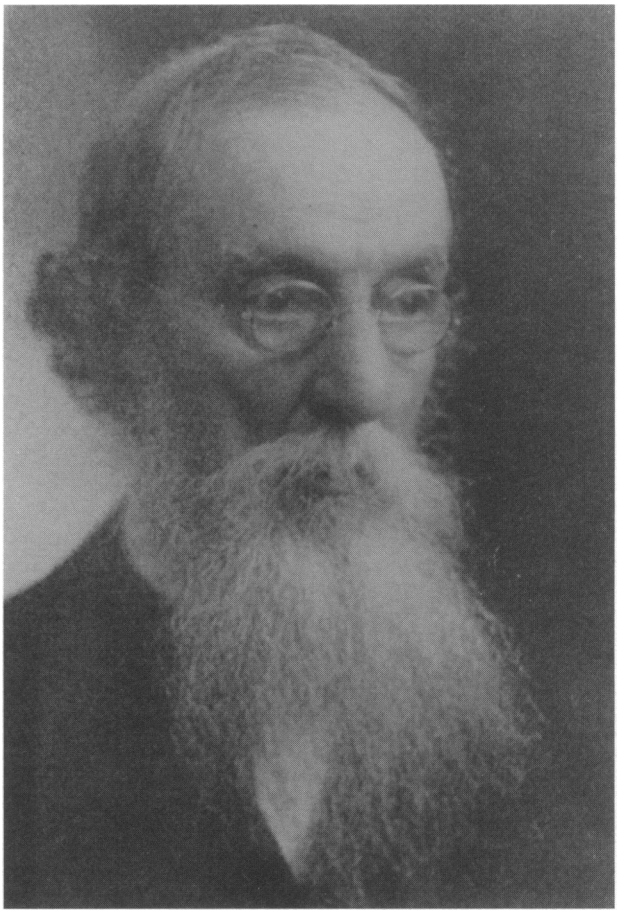

Figure 2 Sir Jonathan Hutchinson FRS *circa* 1890. Reproduced by kind permission of the Royal London Hospital Archives

'average pupil'. Within one year of the family's move to London, Treves had his first encounter with intussusception — his sister, Mary Elizabeth tragically died of the condition at the age of 13 years.[33] In 1871, Treves entered University College London where he did his preclinical studies before attending The London Hospital Medical College in October 1872.[34] Here, he came under the influence of Sir Jonathan Hutchinson (Fig. 2) and John Hughlings Jackson. By 1883, Treves was head of the Anatomy Schools at the London Hospital and a full-surgeon to the Hospital (Fig. 3).

Treves is best remembered for his work on appendicitis, including his involvement in the surgical treatment of King Edward VII's appendix abscess on the eve of his Coronation in 1902, as well as his involvement with Joseph Merrick, the 'Elephant Man'. However, his work as an anatomist stimulated his interest in pathology and he became a regular speaker at meetings of the Pathological Society of London. In 1883, he received the Jacksonian Prize of The Royal College of Surgeons of England for his essay on intestinal obstruction which formed the basis for his subsequent acclaimed book on this subject.[33] In the 1899 edition of *Intestinal Obstruction*, Treves defined the role of laparotomy in the treatment of intestinal obstruction:[35] 'it is less dangerous to leap from the Clifton Suspension Bridge than to suffer from acute intestinal obstruction and decline operation'.

One year after Treves commenced his medical education, J. Lewis-Smith published his treatise on diseases of infancy and childhood in which he commented that in intussusception:[36] 'I apprehend that there are few surgeons at the present day who would perform or recommend this mode of treatment [laparotomy] in a child'.

The first certain recorded laparotomy for intussusception in a child was performed by Gerson and reported by Hachmann of Hamburg in 1840.[37] The child was 12-weeks-old and the bowel was perforated during attempted manual reduction with a fatal outcome. Spencer-Wells attempted a similar laparotomy on a moribund child aged 4 months with intussusception who survived the operation but died 5 h later.[38] On 11 November 1873, Hutchinson read a paper before the Royal Medical and Chirurgical Society, reporting the first successful laparotomy and reduction of an ileocolic intussusception performed under chloroform anaesthesia in 1871 on a 2-year-old girl at the London Hospital, after failed attempts at hydrostatic enema reduction.[39] Treves may well have been present at the operation and no doubt would have been influenced by Hutchinson who advocated early operation in infants with intussusception in whom enemas were not immediately successful. In 1875, other members of the Royal Medical and Chirurgical Society from St Bartholomew's Hospital and Guy's Hospital in London announced similar successes to that of Hutchinson.[40,41]

Figure 3 Frederick Treves FRCS circa 1892. Reproduced by kind permission of the Royal London Hospital Archives

Based upon these experiences together with a detailed review of European literature and pathological specimens, Treves presented his ideas on the pathology and treatment of intussusception in 1885,[42] much of which holds true today. He described intussusception as being responsible for 30% of all cases of intestinal obstruction and classified the lesions by their anatomical location.[42,43] He distinguished idiopathic intussusception ('no evident exciting cause'), most commonly seen in children, from those cases associated with a pathological lead point such as a polyp, Meckel's diverticulum, or intestinal lymphoma.[43] Importantly, he pointed out that intestinal obstruction and strangulation need not co-exist and discussed the condition of chronic intussusception in which neither may occur. Treves also recognised agonal intussusceptions, the multiple, short, non-obstructing, easily reducible small bowel intussusceptions found at post

mortem, most often in brain injured children. He noted that these were both antegrade and retrograde invaginations and postulated that they resulted from intestinal dysmotility. On the subject of spontaneous elimination of the gangrenous intussusceptum, Treves commented that after review of the literature and his clinical experience that:[42] 'Spontaneous elimination, therefore, holds out somewhat delusive hopes, and affords but the feeblest support to the expectant treatment'.

Treves considered this to be particularly true in young children in whom intussusception is most common. Nevertheless, he accepted that spontaneous reduction of an intussusception could occur but commented that the overall mortality from the condition was at least 70% and that intussusception was 'exceedingly fatal' in infants. In the light of such observation, Treves devised the axiom that:[42] 'the treatment of intussusception should be prompt and active, and no reliance is to be placed on expectant measures'.

The first element of treatment he included was the use of opium. He postulated that by reducing peristalsis, opium may reduce the progression of the disease. However, the other advantages of opium were not lost on Treves for:[42] 'The pain, moreover, is checked, the symptoms of shock are relieved, the pulse improves, the temperature rises, and the vomiting becomes less frequent and less distressing. The patient is placed in the most favourable possible position for the employment of further treatment.'

Treves advised no oral intake, other than small quantities of ice, in acute intussusception. He recommended the gradual administration of enemas of warm water (in preference to air). This was facilitated by using Mr Lund's apparatus, comprising an elastic pad and handle which prevented the escape of fluid from the anus. He condemned the use of carbonic acid enemas, but appreciated the value of enema administration to a relaxed child, either by the use of opium, or chloroform anaesthesia. Failure of enema reduction prompted Treves to proceed immediately to laparotomy, which was similarly carried out under chloroform anaesthesia. In his 1885 paper, Treves advised 'strict antiseptic precautions', although it is unclear as to how closely he adhered to Listerian principles at this time. When one of Treves's students first watched him operating in 1882, he wore an old and well-worn coat which he boasted:[44] 'was so stiff with congealed blood after many years of use that it would stand upright when placed on the floor'. By the 1890s, Lister's teachings on antisepsis had effected a considerable change such that:[45] 'Treves invariably changed into a white coat and scrubbed his hands meticulously before operating', even though the assistant who prepared his sutures sometimes sucked the thread before inserting it in the needle!'

Treves emphasised the urgency required for a successful surgical outcome when dealing with intussusception and roundly condemned the use of massage, electric therapies and mercury treatments prior to laparotomy. By stating that:[42] 'Their employment is in opposition to the chief teachings to be derived from a study of the pathology of the disease,' Treves became an early proponent of evidence-based medicine.

In 33 patients in whom Treves performed a laparotomy for intussusception the overall mortality was 73%.[42] However, the ease of manual reduction was a highly significant prognostic factor — patients undergoing an easy reduction had a mortality of 30% compared with 'difficult' reductions, where the mortality was 91%. Treves noted that the presence of gangrenous bowel in childhood intussusception was invariably fatal. According to the Royal London Hospital Archives between 1895 and 1897, this coninued to remain the case right up until Treves retired from the Hospital in 1898 (Jonathan Evans, personal communication). He, therefore, proposed resection of a gangrenous intussusception and the formation of stomas, but he condemned primary anastomosis at the time of resection.

Treves's pertinent observations and lucid writing hold much value today and the current treatment of intussusception has altered little from his observations made over a century ago. Currently, children with intussusception are managed by attempted enema reduction, usually using an air enema under fluoroscopic control, and laparotomy with reduction or resection is reserved for those in with peritonitis or when pneumatic or hydrostatic reduction has failed. Overall mortality from the condition is less than 1% but this figure is higher in older children and in those with an isolated small bowel intussusception; avoidable factors can be identified in up to 60% of childhood deaths from intussusception.[46]

Acknowledgements

We are indebted to Jonathan Evans, Trust Archivist at The Royal London Hospital Archives and Museum, and to Elizabeth Allen, Qvist Curator at the Hunterian Museum, Royal College of Surgeons of England, for their valuable, courteous and prompt help with our research.

References

1. Hippocrates. Hippocratic writings. In: Lloyd G, ed. *Hippocratic Writings,* 4th edn. London: Penguin, 1983; 218–9.

2. Peyer J. *Exercitatio anatomico-medica de glandulis intestinorum, earumque usu et affectionibus*. Scafhusae: Onophrius et Waldkirsch, 1677.
3. Barbette P. *Thesaurus Chirurgicae*. London: Moses Pitt, 1676; 324
4. Velse C. *De mutuo intestinorum ingressu*. Lugduni Batavorum, J Luzac, 1742.
5. Ravitch MM. *Intussusception in Infants and Children*. Springfield: Charles C Thomas, 1959; 3–11.
6. Dougall W. History of a case of ileus in which a considerable portion of the intestine was voided by stool. *Medical Commentary (London)* 1785; **ix**: 278–81.
7. Hull J. On intussusception. *Med Physiol J* 1802; **vii**: 32–8.
8. Langstaff G. Intussusception. *Edin Med Chir J* 1807; **3**: 262–8.
9. Palmer JF. *The Works of John Hunter FRS*. London: Longman, Rees, Orme, Brown, Green and Longman, 1837; 3: 587–93.
10. West KW, Stephens B, Vane DW, Grosfeld JL. Intussusception: current management in infants and children. *Surgery* 1987; **102**: 704–709.
11. Hunter J. On introsusception. *Trans Soc Improvements Med Chir Knowledge* 1793; **i**: 103–18.
12. Lettsom J. *The history of an extraordinary introsusception. With an account of the description by Whately*. London; 1786.
13. Allen E, Turk JL, Murley R. *The Case Books of John Hunter FRS*. London: R Soc Med Services Ltd, 1993; 573–4, 602–5.
14. Leichtenstern O. Intussusception, invagination und darmeinschiebung. *Ziemssen's Cyclopaedia of the Practice of Medicine* 1877; **7**: 610–24.
15. Blacklock A. On inflation of the bowels. *Glasgow Med J* 1831; **4**: 138–40.
16. Mitchell S. Intussusception in children. *Lancet* 1837; **i**: 904.
17. Ball R. Case of intussusception of bowels; successfully treated by copious enemata of infusion of tobacco. *Virginia Med Month* 1885; **xii**: 664.
18. Ballard T. A case of supposed invagination of the intestine in a child aged twenty months, successfully treated. *Lancet* 1859; **i**: 137–41.
19. Beach E. Seltzer water injections in intussuception; two cases successfully treated. *New Orleans Med Surg J* 1885; **xiii**: 200–2.
20. Beemer J. Intussuception cured by forcing air into the intestines. *Med Chir Rev* 1839; **xxx**: 645.
21. Blacklock A. Case of colonic intussuception, with some observations on insufflation as a remedy in acute obstructive diseases of the intestines. *Madras Q J Med Sci* 1863; **vi**: 309–25.
22. Cousins E. Incarcerated intussusception in a child successfully treated by inflation. *BMJ* 1862; **i**: 647.
23. Collier H. Acute intussusception in an infant eighteen weeks old; stercoraceous vomiting; inflation by water per anum; rapid subsidence of serious symptoms; recovery. *Lancet* 1884; **ii**: 366.
24. Eastes G. Case of intussusception treated by inflation and distensive enema; recovery. *Lancet* 1869; **ii**: 669, 736.
25. Gorham G. Observations on intussusception as it occurs in infants. *Guy's Hosp Rep* 1838; **iii**: 330–52.
26. Miles C. Case of acute intussusception in an infant reduced by inflation with warm water; recovery. *Med Times Hospital Gazette* 1896; **xxiv**: 291.
27. Wilks J. Intussusception in an infant cured by inflation of the bowel. *Lancet* 1870; **i**: 731.
28. Warren J. Two cases of intussusception successfully treated by fluid injections. *New York Med J* 1875; **xxi**: 490–7.
29. Greig D. On insufflation as a remedy in intussusception. *Edin Med J* 1864; **10**: 306–15.
30. Hirschsprung H. Et Tilfaelde af Subakut Tarminvagination. *Hosp Tid* 1876; **3**: 321–7.
31. Hirschsprung H. Hundertundsieben falle von Darminvagination bei Kindern, behandelt im Konigin Louisen-Kinderhospital in Kopenhagen wahrend der Jahre 1871–1904; kurz tabellarische Darstellung. *Mitt Grenzgeb Med Chir* 1905; **14**: 555–74.
32. Holmes T. Obstruction and intussusception. In: *Surgical Treatment of Diseases of Infancy and Childhood*. London: Longmans, 1868; 568–71.
33. Trombley S. *Sir Frederick Treves: an extra-ordinary Edwardian*. London: Routledge, 1989.
34. Evans J. Sir Frederick Treves, Surgeon Extraordinary. *London Hosp Gazette* 1997; 9–13.
35. Treves F. Intussusception. In: *Intestinal Obstruction: Its Varieties with their Pathology, Diagnosis, and Treatment*, 2nd edn, London: Cassell, 1899.
36. Lewis-Smith J. *A Treatise on Diseases of Infancy and Childhood*. London, 1872.
37. Hachmann H. A case of intussusception. *Zeitschrift Ges Med* 1840; **14**: 289–303.
38. Spencer-Wells T. Intussusception of caecum and colon replaced by gastrotomy. *Trans Pathol Soc London* 1863; **xxvi**: 541–2.
39. Hutchinson J. A successful case of abdominal section for intussusception with remarks on this and other methods of treatment. *Med Chir Trans* 1874; **57**: 31–76
40. Marsh H. A case in which abdominal section was successfully performed for intussusception in an infant seven months old. *Med Chir Trans* 1876; **59**: 79–84
41. Fagge CH, Howse HG. A case of intussusception in an adult without symptoms of strangulation treated successfully by abdominal section. *Med Chir Trans* 1876; **59**: 85–98
42. Treves F. Treatment of intussusception. *Proc Med Soc London* 1885; **8**: 83–94
43. Treves F. Intussusception. In: *Intestinal Obstruction: Its Varieties with their Pathology, Diagnosis, and Treatment*. 2nd edition, London: Cassell, 1899; 141–84
44. Watson F. *Dawson of Penn. Chatto & Windus*, London, 1950
45. Montgomery-Smith EC. Recollections of an old Londoner. *London Hosp Gazette* 1961; **64**: 105
46. Stringer M, Pledger H, Drake D. Childhood deaths from intussusception in England and Wales. *BMJ* 1992; **304**: 737–9